You don't need a plumber to replace those clogged pipes in your body!

By Amy Kim

Have you ever had to use a plumber's snake or chemicals like Draino because the sink is clogged yet again? This is an all too familiar scenario, where we notice that the sink is pooling water and not draining correctly because hair, food, or maybe your kid's toy is stuck in the pipes. Our blood vessels function similarly to the pipes in our houses. When they operate normally, vessels transport blood throughout the body in order to deliver oxygen and other nutrients, and to remove waste. Vascular disease is the condition that occurs when the network of blood vessels is not working properly thereby causing a lack of blood flow to organs and tissues of the body, similar to clogged pipes [1]. The wide range of vascular diseases that afflict people worldwide include aneurysms, atherosclerosis, blood clots, coronary artery disease, stroke, pulmonary artery disease (PAD), and vasculitis [1]. Depending on the vascular disorder, medical interventions, like pharmaceuticals and surgical procedures to restore normal blood flow, may be possible. Physicians also typically recommend lifestyle changes surrounding diet and exercise. All of these interventions are aimed at unclogging vessels. But what if the vessels are too damaged? In that case, the only effective treatment would be new blood vessels.

Scientists have been hard at work to come up with an alternative solution for vascular disease using human induced pluripotent stem cells (hiPSCSs), also known as master cells [2]. These master cells are capable of turning into ANY cell type in the body! While scientists are still learning how to create all of the 200+ cells of the body from hiPSCs, they hold the potential to treat a variety of disorders and diseases—including vascular diseases.

To make hiPSCs, scientists start by taking any cell from the human body, often times they use a type of skin cell called a fibroblast. The scientists then deprogram the fibroblasts in a way that causes them to lose their "skin cell" qualities and revert back to an early embryonic-like state. Similar to the cells of the very early embryo, hiPSCs have the potential to develop into any cell type—including the cells that make up blood vessels.

In the laboratory of Dr. Ping Zhou at UC Davis, we are interested in turning hiPSCs into endothelial cells (ECs), which are the cell type that line the inside of our blood vessels. Though the research is in its early stages, scientists have figured out a way to go from hiPSCs to ECs by using a combination of proteins called growth factors [3]. Now the goal is to use the hiPSC-derived ECs to create blood vessels, with the ultimate objective of being able to replace damaged vessels in individuals suffering from vascular disease.

Do these lab-generated ECs actually work? Scientists have confirmed with functional tests that hiPSC-derived ECs have the same functions as naturally-occurring ECs found in the body. But how well do they function when introduced to an organism? A study addressed this question by injecting hiPSC-derived ECs into mice that were suffering from restricted blood flow in their hind legs. After 10 weeks, scientists observed branches of blood vessels within the site of injection in these mice. Even better, the vessel branches were found to be functional! The hind limbs that once had nonfunctioning blood vessels and lacked blood flow, grew new blood vessels and gained normal blood flow![4]

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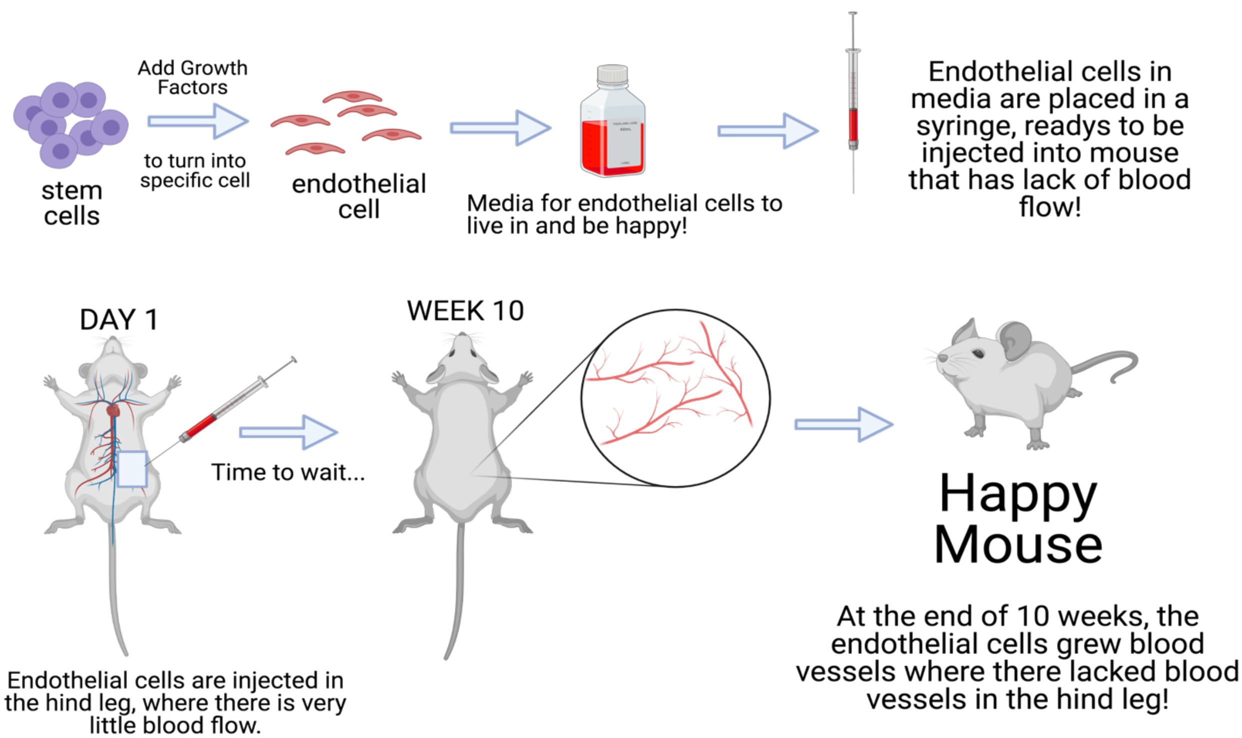

Figure 1

A diagram of how scientists went from stem cells to inserting differentiated cells into a mouse to see if they functioned correctly.

This research is still in its early stages, yet already there are a few noteworthy findings. First, there is a better understanding of what growth factors are required in order to go from a master cell into an endothelial cell. From this understanding, scientists have found an efficient and cost-effective way to produce a nearly pure population of these specialized ECs. Lastly, the ECs have been shown to function normally in an animal model in their ability to restore blood flow.[4] These findings get us one step closer to finding a therapeutic treatment—custom made blood vessels—for the vascular diseases that affect our family, friends, and neighbors.

References

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